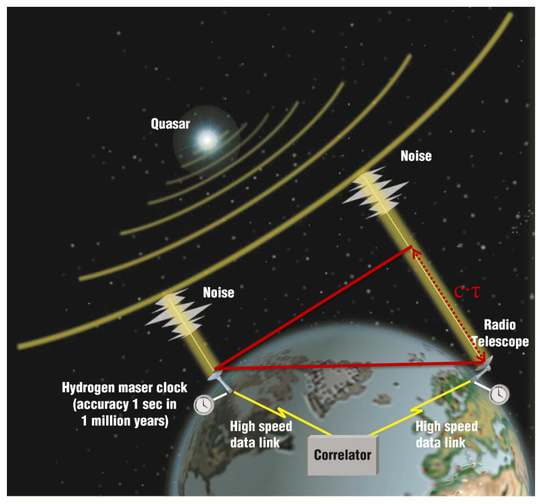
Activities of the International VLBI Service

Dirk Behrend

NVI, Inc./NASA Goddard Space Flight Center, Greenbelt, MD, USA

Very Long Baseline Interferometry (VLBI)



How does VLBI work?

The VLBI observable is the difference in the arrival time of a radio signal (from a quasar) at two different radio telescopes. The measured time delay, using the speed of light, can be interpreted as a distance. The distance is the component of the baseline toward the source (quasar). By observing many sources, all components of the baseline can be determined.

International VLBI Service (IVS)

The **International VLBI Service for Geodesy and Astrometry (IVS)** is an international collaboration of organizations which operate or support VLBI components:

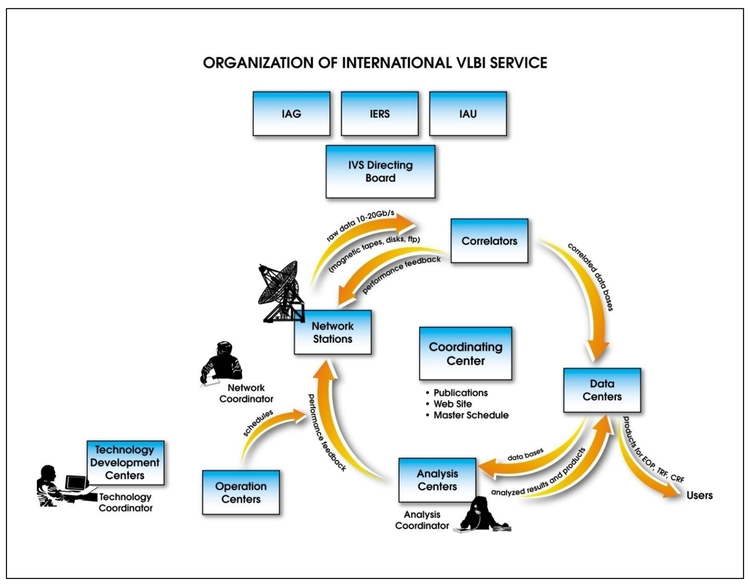
- IVS inauguration was on March 1, 1999.
- IVS 10th Anniversary event on March 25, 2009.
- 79 permanent components supported by 41 institutions in 20 countries.
- ~280 Associate Members.

IVS is a service of

- **IAG** – International Association of Geodesy
- **IAU** – International Astronomical Union
- **WDS** – World Data System (applied for membership)

IVS goals:

- provide a service to support geodetic, geophysical, and astrometric research and operational activities;
- promote research and development in the VLBI technique;
- interact with the community of users of VLBI products and integrate VLBI into a global Earth observing system.



Main activities:

- interacts closely with the IERS, which is tasked by IAU and IUGG with maintaining the international celestial and terrestrial reference frames (ICRF and ITRF);
- coordinates VLBI observing programs;
- sets performance standards for the observing stations;
- establishes conventions for data formats and products;
- issues recommendations for analysis software;
- sets standards for analysis documentation;
- institutes appropriate product delivery methods in order to insure suitable product quality and timeliness.

All **VLBI data** and results in appropriate formats are archived in data centers **and publicly available** for research in related areas of geodesy, geophysics, and astrometry. The IVS data set extends from 1979.

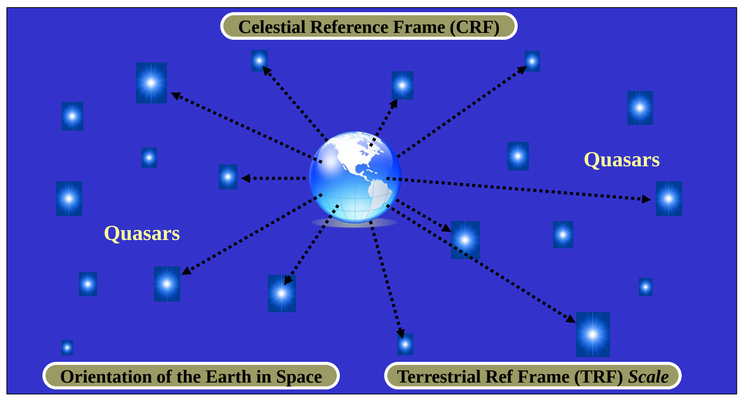
IVS Products

Products (VLBI as unique contributor):

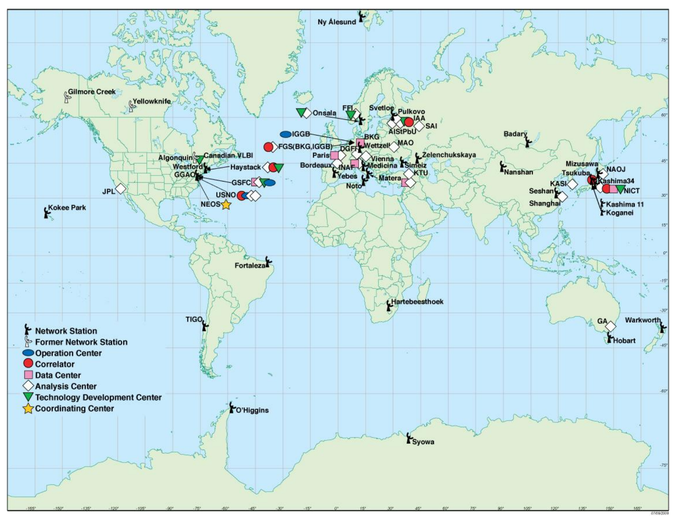
- Definition and realization of the International Celestial Reference Frame (ICRF).
- Monitoring of Universal Time (UT1) and length of day (LOD).
- Monitoring the coordinates of the celestial pole (nutation and precession).

Products (VLBI as significant contributor):

- All components of Earth Orientation Parameters (EOP) at regular intervals.
- Station coordinates and velocity vectors for the realization and maintenance of the International Terrestrial Reference Frame (ITRF).



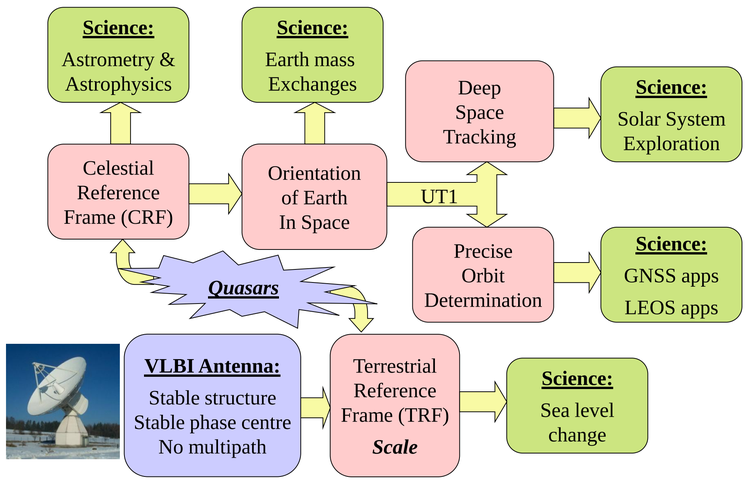
IVS Components



IVS consists of:

- **30 Network Stations**, acquiring high performance VLBI data,
- **3 Operation Centers**, coordinating the activities of a network of Network Stations,
- **6 Correlators**, processing the acquired data, providing feedback to the stations and providing processed data to analysts,
- **6 Data Centers**, distributing products to users, providing storage and archiving functions,
- **26 Analysis Centers**, analyzing the data and producing the results and products,
- **7 Technology Development Centers**, developing new VLBI technology,
- **1 Coordinating Center**, coordinating daily and long term activities.

Roles of VLBI



IVS Data Centers

Data Centers provide the following functions:

- receive and archive schedule files from Operation Centers,
- receive and archive log files and ancillary data files from the Network Stations,
- receive and archive data products from the Analysis Centers,
- provide access and public availability to IVS data products for all users.

Three Primary Data Centers (DCs):

- CDDIS (USA), BKG (Germany), and OPAR (France).
- DCs mirror their data holdings three times per day.
- Mirroring is done between pairs of DCs.

VLBI2010 and Outlook

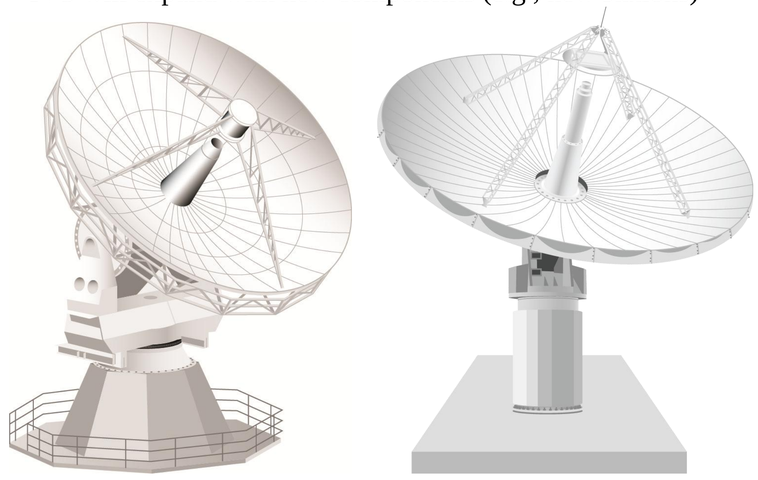
VLBI2010: Next Generation VLBI System

- ***Why a new system?***
  - aging infrastructure
  - new technologies available
  - new scientific requirements
- ***VLBI2010 goals:***
  - 1-mm position accuracy (based on a 24-hour observation)
  - continuous measurement of station position and EOP
  - Turnaround time to initial products in <24 hours

VLBI2010: Key Characteristics	
Antenna diameter:	≥12 m
Antenna slew rate: Azimuth = 12°/s; Elevation = 6°/s	
Frequency range:	2–14 GHz
Polarization:	dual linear
Number of bands:	4
Bandwidth/band:	1 GHz
Total data rate:	32 Gbps
Record/xmit rate:	8 Gbps
Back end:	digital
Correlator :	Software

Future Outlook:

- VLBI2010 is expected to perform significantly better than the legacy (S/X) system
- VLBI2010 will be a key technique within the Global Geodetic Observing System (GGOS)
- geographical gaps will be closed/reduced
- IVS will expand with new components (e.g., new stations)



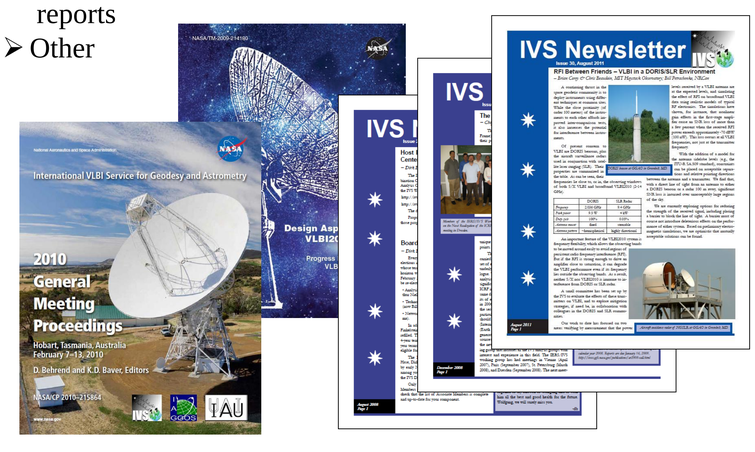
Publications

❖ **Annual Reports:**
- ➢ AR1999, AR2000,..., and AR2010
- ➢ print and electronic versions

❖ **General Meeting Proceedings:**
- ➢ GM2000, GM2002, and GM2010
- ➢ print and electronic versions

❖ **IVS Newsletter:**
- ➢ Tri-annual issues (April, August, and December)
- ➢ print and electronic versions
- ➢ since December 2001

❖ **Special publications:**
- ➢ Working Group and Committee reports
- ➢ Other



`http://ivscc.gsfc.nasa.gov/publications/`

E–mail: dirk.behrend@nasa.gov